

Task: 321**Task Title: Systems modeling relating spatially- and temporally-varying exposure to outcomes at higher levels of biological organization****CSS****Topic/Theme: Systems Models****Project: 2.4 Systems approaches to assess individual and population risks****Rationale and Research Approach:**

Rationale: When setting regulations for managing pesticide and chemical use, the EPA looks at potential harm to wildlife. But our ability to accurately predict ecologically relevant effects from chemicals has been limited. Outside of the laboratory, many indirect factors such as habitat quality, weather, parasites, and predators can quickly take on greater importance than direct exposure to chemicals. For example, pesticide exposure in conjunction with low habitat quality could make individuals more susceptible to parasite or disease infections, and thus cause higher mortality and lower reproductive success. Habitat quality itself can be affected by pesticide exposure through impacts on plant and animal community structure and function. In addition, how animals use increasingly fragmented habitats across a landscape certainly affects the frequency of their exposure to toxics. Nevertheless, EPA's chemical risk assessments usually have focused only on impacts to individual animals, and have estimated primarily those effects caused by direct toxicity following exposure. These limitations have stemmed in part from a lack of adequate analytic tools.

Approach: ORD has developed a spatially-explicit, individual-based, life history simulator that can evaluate the impacts to wildlife populations likely to result from multiple interacting threats (HexSim). This task will use this model to illustrate how risk assessments might be developed that capture the impacts of multiple interacting threats to wildlife populations at large spatial and temporal scales. Examples of such interacting threats include pesticide interactions, environmental stochasticity, changes in habitat composition, distribution, and quality (due in part to off-target pesticide drift), habitat fragmentation, competition, predation, wildlife diseases, and climate change. Data will be collected and analysis carried out to determine how information on these threats can be incorporated into HexSim.

HexSim is an extension of the PATCH simulation model, which was used in the analyses conducted for more than 30 peer-reviewed publications. HexSim has thus far been used to investigate the effects of land-use change and the synergistic effects of land-use and climate change, and it is currently being employed by the U.S. Fish and Wildlife Service in the 2010 spotted owl recovery strategy. HexSim is also being used in a study of anticoagulant rodenticide impacts on the San Joaquin kit fox, under a cooperative agreement between ORD and the University of Washington.

Anticipated 5 year task

Expected products from task:

ORD will develop and deliver tools and methods that can be used to evaluate indirect and direct pesticide impacts on wildlife populations. The principal tool will be HexSim, and enhancements will be made to the model over the course of the study. An extension of HexSim for aquatic populations will be considered as part of this effort.

ORD will develop case studies that illustrate how EPA's risk assessments may be extended to include multiple interacting threats, a variety of ecosystem types, and to large spatial and temporal scales.

Outputs from Project related to this task:

The development of an integrated computational system for estimating environmental concentrations in support of spatially and temporally explicit exposure/risk assessments was designated as a 'must-do' idea by OCSPP. This task will develop such a system. Specifically, it will lead to the further development and application of a spatially-explicit model (e.g., HexSim) for evaluating the risks from spatially structured chemical and non-chemical stressors on wildlife and human populations across small and large areas or regions.

Should this task idea be considered a cross-**ORD ITR task?:** Yes**Anticipated Start Date:** Q1 2012**Anticipated End Date:** Q4 2016**Milestones:****Primary Contact:****Name:** Nathan Schumaker**L/C:** NHEERL**Division:** WED

Collaborators (known or proposed):

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Could NCER contribute to this task?

No

NCER FTE:

FTE:

NCCT:

NERL:

NHSRC:

NCEA:

NHEERL: 1

NRMRL:

Additional FTE Details:Extramural \$120K / year for 5 yearsExtramural CSC or student services contractResourcesResourcesEstimate:Details: